

emies at Buda Pest, Copenhagen, Berlin, Rome, Bruxelles, and Philadelphia; Editor of the *Zoologischer Anzeiger*, Leipzig; Société Vaudoise, Lausanne; Cav. Damiano Muoni, Milan; Editor of the *Revue Politique*, Paris; Society of Commercial Geography, Bordeaux; Editor of the *Revista Euskara*, Pamplona; Royal Astronomical Society, Dr. C. William Siemens, and the Editors of the *Chemists' Journal*, and *Nature*, London; *American Journal*, and Yale College, New Haven; Metropolitan Museum, N. Y.; Pennsylvania Historical Society, Franklin Institute, *Journal of Pharmacy*, and *Medical News*, and Mr. Lorin Blodget, Philadelphia; Mr. P. W. Shaefer, Pottsville; U. S. National Museum, Smithsonian Institution, and Department of the Interior, Washington, D. C.; American Philological Association; Dr. Robert Peter, Frankfort, Ky.; Editor of the *Revista Científica Mexicana*, and the Ministerio de Fomento, Mexico.

Prof. E. D. Cope presented a paper "On the genera of the Creodonta."

On account of the small attendance the election of members was postponed until the next stated meeting.

Pending nominations Nos. 904, 909 to 915, 917 to 919, and new nomination No. 920, were read.

And the meeting was adjourned.

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*On the Genera of the Creodonta. By E. D. Cope.*

(Read before the American Philosophical Society, July 16, 1880.)

For the characters of this group of the unguiculate mammalia, the reader is referred to the fourth volume of the final Report of the U. S. Geol. Survey W. of the 100th Mer., under Capt. Wheeler Pt. ii, p. 72.

*History.* MM. Laurillard, Pomel and others have referred the European *Creodonta* to the *Marsupialia*, on account of the great similarity of the dentition. MM. De Blainville and Gervais have, on the other hand, regarded them as placental, a view which I have assigned reasons\* for believing to be the correct one. M. Filhol has recently shown that the replacement of the dentition in *Hyænodon*, which has some affinities with

\* Proceedings Academy, Phila., 1875. Paleontological Bulletin No. 20, Dec., 1875.

the *Creodonta*, is quite as in true placental *Carnivora*. Professor Gaudry has expressed the opinion that the *Creodonta* are the descendants of the *Marsupialia*.\* I incline to maintain another view.

If we suppose that the *Creodonta* are the descendants of the *Marsupialia*, we must suppose that the *Insectivora*, to which they are related, are also the descendants of the *Marsupialia*, and this is on various grounds not very probable. The lower forms of unguiculate mammalia with small cerebral hemispheres are very much alike in important characters, and to these I have given the name of *Bunotheria*. I suspect that this group is as old as the *Marsupialia*, and may even have given origin to it. That it developed contemporaneously with it in various parts of the world is evident.

*Restoration.* The Wasatch beds of New Mexico have yielded remains of more than a dozen species, which ranged from the size of a weasel to that of a jaguar. The Bridger beds of Wyoming probably contain as many species, which range from small size to the dimensions of a bear.

In general appearance, the *Creodonta* differed from the *Carnivora*, in many of the species at least, in the small relative size of the limbs as compared with that of the head, and in some instances as compared with the size of the hind feet. The feet are probably plantigrade, and the posterior ones capable of some degree of horizontal rotation. The probable large size of the rectus femoris muscle indicates unusual power of extension of the hind limb. They were furnished with a long and large tail. Probably some of the species resembled in proportions the *Mystomys* and *Solenodon*, now existing in Africa and the West Indies, but they mostly attained a much larger size. The habits of many of them were probably aquatic.

*Classification.* To the *Creodonta* I have referred,† on the information which we possess, the genus *Arctocyon* of Blainville. Professor Gervais has discovered that it possessed the very small cerebral hemispheres characteristic of the *Creodonta*. The olfactory lobes are large, and project far beyond the hemispheres, while not only the cerebellum, but probably the corpora quadrigemina, were exposed behind. The tarsal articulation and the posterior part of the mandibular bones are unknown, hence this reference is not certain. Professor Gervais‡ regards it, after Laurillard,§ as a marsupial, and establishes an especial family of the order for its reception. It is, however, more probable that its affinities are with the contemporary genera of flesh-eaters, *Palæonyctis* Blv., and *Pterodon* Blv., genera which have near allies among the American forms. *Palæonyctis* was the contemporary of the Coryphodons in the Suessonian period of Western Europe, and presents a strong resemblance to *Amblyctonus* in its mandible, the only part of the skeleton known. The posterior part of the ramus is not inflected according to Gervais, and he therefore does not refer it to the *Marsupialia*.|| The nearest European representative of *Oryxena* is *Ptero-*

\* Enchainements du Monde Animal, 1873, p. 21.

† Report Capt. G. M. Wheeler, Expl. Surv. W. 100 Mer. 1877, iv, pl. ii, p. 88.

‡ Nouv. archives du museum, 1870, p. 150.

§ Dict. univ. d'hist. naturelle, ix, p. 400.

|| Nouv. archives du museum, 1870, 151.

*don*, in which the form of the mandible also forbids a reference to the *Marsupialia*, as Gervais has remarked. Both genera are doubtless members of the sub-order of *Creodonta*. The genus *Hyænodon*, on the other hand, is not referable to the same group, for I find in a specimen of the *H. requieni* from Desbruges, preserved in the Museum of the Jardin des Plantes, that the scaphoid and lunar bones are coössified. Moreover the figure given by Professor Gervais\* representing the brain of the originally-described type, *H. leptorhynchus* of the Miocene period, displays characters of the true *Carnivora*. The anterior part of the cranial cavity of the specimen molded is broken away.

It is possible that the genus *Diacodon* Cope belongs here also; its species resemble slightly the *Marsupialia* in the inferior dentition, and are of small size.

The genus *Mesonyx*,† which I discovered in the Bridger beds of Wyoming, has the trochlear face of its astragalus completely grooved above as in the true *Carnivora*, and its distal end presents two distinct facets, one for the cuboid, and the other for the navicular bones. It represents on this account a peculiar family, the *Mesonychidæ*.

There are various degrees of development of the sectorial structure of the molars in this sub-order. In some of them, as *Didymictis*, only one of the inferior molars presents this structure; in others two, and in others three. In one type, the last superior molar is longitudinal; in others, it is transverse. In *Arctocyon* the superior true molars are tubercular.

I have heretofore‡ defined three families, the *Amblyctonidæ*, the *Oxyænidæ*, and the *Arctocyonidæ*. I now add the *Miacidæ* and *Mesonychidæ*. The definitions are as follows:

#### I. Ankle joint plane transversely.

|   |                       |
|---|-----------------------|
| True molars above and below tubercular; last superior not transverse.....                     | <i>Arctocyonidæ</i> . |
| Superior true molars tubercular; first inferior "tubercular-sectorial".....                   | <i>Miacidæ</i> .      |
| Last superior molar trenchant, transverse; inferior true molars tubercular-sectorial.....     | <i>Oxyænidæ</i> .     |
| Last superior molar longitudinal; inferior true molars without developed sectorial blade..... | <i>Amblyctonidæ</i> . |

#### II. Ankle joint tongued and grooved, or trochlear.

|  |                      |
|--|----------------------|
| Inferior molars each with one conic tubercle and a heel; no developed sectorial blade..... | <i>Mesonychidæ</i> . |
|--|----------------------|

I now give the characters of the genera. All these are derived from examination of typical specimens. The opportunity of doing this I owe to the kindness of Messrs. Leidy, Gervais, Gaudry, Filhol and Lemoine.

\* Loc. cit., pl. vi, fig. 5.

† Ann. Rept. U. S. Geol. Surv. Terrs., 1872, p. 550.

‡ Report Capt. G. M. Wheeler's Expl. Surv. W. 100 Mer, 1877, iv, pl. ii, p. 89.

## ARCTOCYONIDÆ.

- Premolars  $\frac{4}{1}$ ; the first inferior one-rooted; the last inferior well developed..... *Arctocyon* Blv.  
 Premolars below, 4, the first two-rooted, the last true molar much reduced..... *Hyodectes*\* Cope.  
 Premolars below, 3, first two-rooted; true molars normal..... *Heteroborus*† Cope.

## MIACIDÆ.

- Inferior tubercular molars two, premolars four..... *Miacis* Cope.  
 Inferior tubercular molars one, premolars four..... *Didymictis* Cope.

## OXYÆNIDÆ.

## I. Inferior molars without internal tubercles.

- Molars,  $\frac{4}{3} \frac{3}{3}$ ; three sectorials in the lower jaw..... *Pterodon* Blv.

## II. Inferior molars with internal cusps.

- Molars,  $\frac{4}{2} \frac{2}{2}$ ; two last inferior molars tubercular-sectorial..... *Oxyana* Cope.  
 Premolars  $\frac{4}{1}$ ; three last inferior molars tubercular-sectorial; the fourth superior with a conic cusp and heel externally..... *Stypolophus* Cope.  
 Premolars  $\frac{4}{1}$ ; three last inferior molars tubercular-sectorial; fourth superior premolar with a simple blade externally..... *Proxiverra* Rütim.

## AMBLYCTONIDÆ.

- Fourth inferior premolar with a broad heel supporting tubercles..... *Amblyctonus* Cope.  
 Dental formula below, 3, 1, 3, 3. Fourth inferior premolar with a cutting edge on the heel..... *Palæonyctis* Blv.

## MESONYCHIIDÆ.

- Inferior molars seven..... *Mesonyx* Cope.  
 Inferior molars five..... *Patriofelis* Leidy.

Of the preceding genera it may be remarked, that the structure of the feet of *Pterodon* being unknown, it may be found hereafter to be necessary to remove it from the *Oxyænida*, although I do not anticipate that such a course will be necessary. *Palæonyctis* is only known by the mandibular dentition, which is very near to that of *Amblyctonus*. So also it is not certain, but only probable, that *Patriofelis* belongs to the *Mesony-*

\* Type *Arctocyon gervaisii* Lemoine, Oss. Foss. des Envir. de Reims, 1878, p. 8.

† Type *Arctocyon duellii* Lemoine, l. c., p. 9.

*chidæ* of the same horizon and locality. The horizontal and geographical distribution of the species of these thirteen genera is as follows :

|   | Lower Eocene. |      | Upper Eocene. |      |
|---|---------------|------|---------------|------|
|   | N. A.         | Eur. | N. A.         | Eur. |
| <i>Arctocyon primævus</i> Blv .....     |               | *    |               |      |
| <i>Hyodectes gervaisi</i> Lem.....      |               | *    |               |      |
| <i>Heteroborus duellii</i> Lem.....     |               | *    |               |      |
| <i>Miacis parvivorus</i> Cope.....      |               |      | *             |      |
| “ <i>edax</i> Leidy.....                |               |      | *             |      |
| “ <i>vorax</i> Leidy.....               |               |      | *             |      |
| <i>Didymictis protenus</i> Cope.....    | *             |      |               |      |
| <i>Pterodon dasyuroides</i> Blv.....    |               | *    |               |      |
| “ <i>biincisivus</i> Filh.....          |               |      |               | *    |
| <i>Oxyæna morsitans</i> Cope.....       | *             |      |               |      |
| “ <i>lupina</i> Cope.....               | *             |      |               |      |
| “ <i>forcipata</i> Cope.....            | *             |      |               |      |
| <i>Stypolophus viverrinus</i> Cope..... | *             |      |               |      |
| “ <i>secundarius</i> Cope.....          | *             |      |               |      |
| “ <i>multicuspis</i> Cope.....          | *             |      |               |      |
| “ <i>strenuus</i> Cope.....             | *             |      |               |      |
| “ <i>minor</i> Filh.....                |               |      |               | *    |
| “ <i>caylusi</i> Filh.....              |               |      |               | *    |
| “ <i>pungens</i> Cope.....              |               |      | *             |      |
| “ <i>brevicalcaratus</i> Cope.....      |               |      | *             |      |
| “ <i>aculeatus</i> Cope.....            |               |      | *             |      |
| “ <i>hians</i> Cope.....                | *             |      |               |      |
| <i>Proviverra typica</i> Rütim.....     |               | *    |               |      |
| <i>Amblyctonus sinosus</i> Cope.....    | *             |      |               |      |
| “ sp. no. 2†.....                       |               | *    |               |      |
| <i>Palæonyctis gigantea</i> Blv.....    |               | *    |               |      |
| <i>Mesonyx obtusidens</i> Cope.....     |               |      | *             |      |
| “ <i>lanius</i> Cope.....               |               |      | *             |      |
| <i>Patriofelis ulta</i> Leidy.....      |               |      | *             |      |

*Phylogeny.* It is among the genera above enumerated that we are to look for the ancestors of the existing *Carnivora*, excepting perhaps the seals, and even these were probably cotemporaries. In those genera without developed internal tubercles of the molars, we may look for the ancestors of the *Hyænodontidæ*, a family which early attained specialization at the expense of strength of structure, and did not survive the lower Miocene period. Such genera may be found in the *Mesonychidæ* as the later, and the *Amblyctonidæ* as the earlier types.

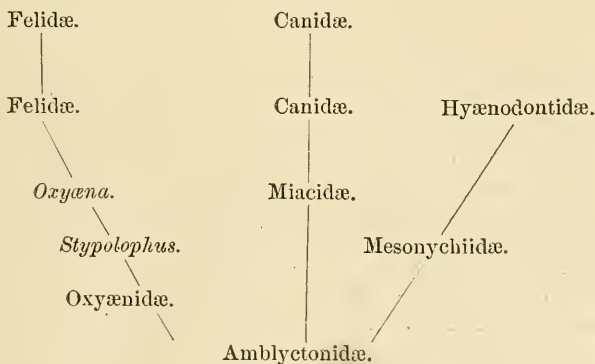
In distinguishing between the ancestors of the *Felidæ* and *Canidæ*, we naturally seek to recognize in each, an anticipation of the leading characters in the dentition which distinguish those families to-day. This consists, in the *Felidæ*, in the successive abbreviation of the true molar series from behind, so that ultimately two molars are lost, and the remaining or anterior one becomes transverse. On the other hand in the *Canidæ*, firstly,

† Represented by a mandible with teeth, from Meudon, associated with the specimens of *Palæonyctis* in the Mus. Jardin des Plantes.



the full number of true molars is retained in some genera, as *Amphicyon*, and only one lost in *Canis*. Secondly, the tubercular character of the posterior molars in both jaws in the *Canidæ* is distinguished from their sectorial character in *Felidæ*. Estimated by these tests the *Miacidæ* are clearly the forerunners of the *Canidæ*, and the *Oxyænidæ* of the *Felidæ*. In *Miacis* we have in fact a near approach to the dentition of *Canis*, in the lower jaw; while in the same part of *Didymictis* posterior abbreviation has commenced, reminding one of *Viverra*. In the *Oxyænidæ*, one degree of posterior abbreviation is seen in *Stypolophus*, where the last superior molar is narrowed and turned at right angles to the others. In *Oxyæna*, the process had advanced a step, for there are but two superior true molars, and the last of these is driven in, transversely. The first true molar is functionally sectorial in this genus, while the last premolar is the true sectorial of the superior series in existing *Carnivora*. In the inferior series there are only two true molars in *Oxyæna*, both primitive, or "tubercular-sectorial" in character. In existing *Felidæ* the second is lost, while the first undergoes great changes in becoming a specialized sectorial. The forms of the *Felidæ*, which are nearest, are the *Cryptoprocta*, and the *Proælorus* of Filhol, but they only follow after a wide interval. I have elsewhere discussed the successive steps in the evolution of the sectorial itself.\* I have also pointed out † the successive shortening of the anterior part of the dental series in the *Felidæ* and other groups of existing *Carnivora*, which came later in time.

The following table will give an idea of these affinities, and the phylogeny to be derived from them :



*Synonymy.* Prof. Gaudry has united *Stypolophus* (*Cynohyænodon* Filhol) with *Proviverra*. After an examination of casts of Rüttimeyer's types preserved in the Museum of the Jardin des Plantes, I retain them as distinct for the reasons given above. Mr. Bosc in an interesting paper on this subject published in the London Geological Magazine for May and

\* Proceedings Acad. Phila., 1875, p. 21.

† *Felidæ* and *Canidæ*, l. c., 1879, p. 169-170.

June, 1880, unites *Didymictis* with *Palæonyctis*.\* Having examined the types of both genera, my conclusion as expressed in the preceding pages is very different. On the other hand, I have good reason for believing the species to which the name *Synop'otherium* was given, *S. lanius*, is really a second species of *Mesonyx*, of larger size than the *M. obtusidens*, and otherwise different. It is likely that some of the species of the Bridger formation, to which Marsh has applied generic names, belong to the *Creodonta*, and may belong to some of the genera described by myself. The fact that no generic definition accompanied the publication of those names, renders their use impracticable.

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*Stated Meeting, August 20, 1880.*

Present, 4 members.

President, Mr. FREDERICK FRALEY, in the Chair.

Mr. Joseph C. Fraley, a newly elected member, was introduced, and took his seat.

Letters of acknowledgment were received from the Royal Society, June 3 (100, 101, 102, 103); the Royal Society, New South Wales, June 14 (101, 102, 103); Royal Institution, July 12 (105); the Victoria Institute, July 10 (105); the Statistical Society, London, July 20 (105); Society of Antiquaries, July 21 (105); University Library, Cambridge, July 19 (105); the Museum, Newcastle-upon-Tyne, July 19 (105); New Hampshire Historical Society, August 12 (106 and List); New Jersey Historical Society, August 11 (106 and List); Essex Institute, August 12 (106 and List); Boston Public Library, August 14 (106 and List); U. S. Military Academy, August 13 (106 and List); Dr. C. H. F. Peters, Litchfield, A. of Hamilton College, Clinton, Oneida county, New York, August 17 (106 and List); American Ethnological Society, New York, August 12 (106 and List); Connecticut Historical Society, Hartford, August 18 (106 and List); American Antiquarian Society, Worcester, August 13 (106 and List); and from Dr. E. Jarvis, Prof. W. P. Blake, Dr. T. M. Drown, and Mr. W. B. Taylor (106 and List).

\*I have just seen this paper, having already written what precedes this paragraph.